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INDEX TO BENET LABORATORIES TECHNICAL REPORTS - 2002

R. D. SHUMAN

APRIL 2003



US ARMY ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER

Close Combat Armaments Center Benét Laboratories Watervliet, NY 12189-4000



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TABLE OF CONTENTS

<u>!</u>	Page
LIST OF REPORTS	1
AUTHOR INDEX	3
SUBJECT INDEX	5
AD NUMBERS	10
REPORT DOCUMENTATION PAGES	11

TECHNICAL REPORTS 2002

REPORT NUMBER	TITLE	AUTHOR	DATE
ARCCB-TR-02001	Sonic Rarefaction Wave Low Recoil	E. Kathe	Jan 02
	Gun	R. Dillon	
ARCCB-TR-02002	Gun Barrel Vibration Absorber to	A. Littlefield	Feb 02
	Increase Accuracy	E. Kathe	
		R. Messier	
		K. Olsen	
ARCCB-TR-02003	Adaptive Gun Barrel Vibration	A. Littlefield	Mar 02
	Absorber	E. Kathe	
ARCCB-TR-02004	Evaluation of University of	G. Kendall	Mar 02
	Tennessee Space Institute's Laser-	P.J. Cote	
	Induced Surface Improvement (LISI)	M. Todaro	
	Technique for Gun Bore Protection	F. Yee	
		C. Rickard	
ARCCB-SP-02005	Index to Benet Laboratories	R.D. Shuman	Apr 02
	Technical Reports - 2002		1
ARCCB-TR-02006	Yield Pressure Measurements and	J.H. Underwood	May 02
	Analysis for Autofrettaged Cannons	D.B. Moak	
		M.A. Audino	
		A.P. Parker	
ARCCB-TR-02007	A Fire Out-of-Battery Tank Gun:	E. Kathe	May 02
	Theory and Simulation	R. Gast	
ARCCB-TR-02008	An Algorithm for the Determination	M.A. Doxbeck	Jul 02
	of Coating Properties from Laser-	M.A. Hussain	
	Generated and Detected Rayleigh	J. Rama	
	Waves Using Wavelet Analysis:	A. Abbate	
	Application to Sputtered Tantalum	J. Frankel	
ARCCB-TR-02009	Characterization of Steels Using a	A.P. Parker	Aug 02
	Revised Kinetic Hardening Model	E. Troiano	
	Incorporating Bauschinger Effect	J.H. Underwood	
A D CCD ATD 00010		C. Mossey	
ARCCB-TR-02010	Dynamically Tuned Shroud for	A.G. Littlefield	Aug 02
	Attenuating Gun Barrel Vibration	E. L. Kathe	
A D C C D TTD 00044		R. Durocher	
ARCCB-TR-02011	Evolution of Surface Structures in	M.A. Johnson	Aug 02
	Sputtered Coatings	P.J. Cote	
ARCCB-TR-02012	Detrended Fluctuation Analysis of	M.A. Johnson	Aug 02
	UV Degradation in a Polyurethane	P.J. Cote	
1 D C C D TO C C C C C C C C C C C C C C C C C C	Coating		
ARCCB-TR-02013	Safe Maximum Pressure	D.C. Smith	Sep 02
	Determination for the M829E3/M256	E.E. Coppola	
	Cannon Qualification Program		

TECHNICAL REPORTS 2002

ARCCB-TR-02014	In-Situ Phase Evolution Study in Magnetron-Sputtered Tantalum Thin Films	S.L. Lee D. Windover TM. Lu M. Audino	Oct 02
ARCCB-TR-02015	Main Battle Tank Flexible Gun Tube Disturbance Model: Three-Segment Model	H.J. Sneck	Oct 02
ARCCB-TR-02016	Characterization of Explosively Bonded and Fired Tantalum Liners Applied to 25-mm Gun Tubes	C. Mulligan M. Audino P. Cote G. Kendall C. Rickard S, Smith M. Todaro	Nov 02
ARCCB-TR-02017	Updated Erosion Modeling Predictions for the M829E3 Round	S. Sopok G. Pflegl C. Rickard	Dec 02

AUTHOR INDEX 2002

AUTHOR	REPORT NUMBER
Abbate, A.	ARCCB-TR-02008
Audino, M.A.	ARCCB-TR-02006 ARCCB-TR-02014 ARCCB-TR-02016
Coppola, E.E.	ARCCB-TR-02013
Cote, P.J.	ARCCB-TR-02004 ARCCB-TR-02011 ARCCB-TR-02012 ARCCB-TR-02016
Dillon, R.	ARCCB-TR-02001
Doxbeck, M.A.	ARCCB-TR-02008
Durocher, R.	ARCCB-TR-02010
Frankel, J.	ARCCB-TR-02008
Gast, R.	ARCCB-TR-02007
Hussain, M.A.	ARCCB-TR-02008
Johnson, M.A.	ARCCB-TR-02011 ARCCB-TR-02012
Kathe, E.L.	ARCCB-TR-02001 ARCCB-TR-02002 ARCCB-TR-02003 ARCCB-TR-02007 ARCCB-TR-02010
Kendall, G.	ARCCB-TR-02004 ARCCB-TR-02016
Lee, S.L.	ARCCB-TR-02014
Littlefield, A.G.	ARCCB-TR-02002 ARCCB-TR-02003 ARCCB-TR-02010

AUTHOR INDEX 2002

Lu, TM.	ARCCB-TR-02014
Messier, R.	ARCCB-TR-02002
Moak, D.B.	ARCCB-TR-02006
Mossey, C.	ARCCB-TR-02009
Mulligan, C.	ARCCB-TR-02016
Olsen, K.	ARCCB-TR-02002
Parker, A.P.	ARCCB-TR-02006 ARCCB-TR-02009
Pflegl, G.	ARCCB-TR-02017
Rama, J.	ARCCB-TR-02008
Rickard, C.	ARCCB-TR-02004 ARCCB-TR-02016 ARCCB-TR-02017
Shuman, R.D.	ARCCB-SP-02005
	111002 21 0200
Smith, D.C.	ARCCB-TR-02013
Smith, D.C. Smith, S.	
	ARCCB-TR-02013
Smith, S.	ARCCB-TR-02013 ARCCB-TR-02016
Smith, S. Sneck, H.J.	ARCCB-TR-02013 ARCCB-TR-02016 ARCCB-TR-02015
Smith, S. Sneck, H.J. Sopok, S.	ARCCB-TR-02013 ARCCB-TR-02016 ARCCB-TR-02015 ARCCB-TR-02017g ARCCB-TR-02004
Smith, S. Sneck, H.J. Sopok, S. Todaro, M.	ARCCB-TR-02013 ARCCB-TR-02016 ARCCB-TR-02015 ARCCB-TR-02017g ARCCB-TR-02004 ARCCB-TR-02016
Smith, S. Sneck, H.J. Sopok, S. Todaro, M. Troiano, E.	ARCCB-TR-02013 ARCCB-TR-02016 ARCCB-TR-02015 ARCCB-TR-02017g ARCCB-TR-02004 ARCCB-TR-02016 ARCCB-TR-02009 ARCCB-TR-02006

SUBJECT	REPORT NUMBER
A723 Steel	ARCCB-TR-02009
Absorbers (Equipment)	ARCCB-TR-02010
Abstracts	ARCCB-SP-02005
Accuracy	ARCCB-TR-02002 ARCCB-TR-02003 ARCCB-TR-02010
Algorithms	ARCCB-TR-02008
Autofrettage	ARCCB-TR-02006 ARCCB-TR-02009
Bauschinger Effect	ARCCB-TR-02006 ARCCB-TR-02009
Bibliographies	ARCCB-SP-02005
Bores	ARCCB-TR-02004
Cannons	ARCCB-TR-02006 ARCCB-TR-02010 ARCCB-TR-02013
Chromium	ARCCB-TR-02004
Coatings	ARCCB-TR-02004 ARCCB-TR-02008 ARCCB-TR-02011 ARCCB-TR-02012
Crusader	ARCCB-TR-02004
de Laval Nozzle	ARCCB-TR-02001
Detrended Fluctuation Analysis (DFA)	ARCCB-TR-02012
Dispersing	ARCCB-TR-02003

Dynamic Scaling Exponents	ARCCB-TR-02011
Dynamics	ARCCB-TR-02002 ARCCB-TR-02003 ARCCB-TR-02010
Elastic Modulus	ARCCB-TR-02009
Elastic Properties	ARCCB-TR-02013
Erosion	ARCCB-TR-02004 ARCCB-TR-02016 ARCCB-TR-02017
Explosive Bonding	ARCCB-TR-02016
Fatigue Life	ARCCB-TR-02009
Finite Element Analysis	ARCCB-TR-02013
Fire Out-of-Battery (FOOB)	ARCCB-TR-02007
Firing Tests (Ordnance)	ARCCB-TR-02002
Fractals	ARCCB-TR-02011 ARCCB-TR-02012
Future Combat System (FCS)	ARCCB-TR-02001 ARCCB-TR-02007
Gun Barrels	ARCCB-TR-02002 ARCCB-TR-02003 ARCCB-TR-02007 ARCCB-TR-02010
Gun Mounts	ARCCB-TR-02007
Gun Tubes	ARCCB-TR-02004 ARCCB-TR-02006 ARCCB-TR-02009 ARCCB-TR-02013 ARCCB-TR-02015 ARCCB-TR-02016

Guns ARCCB-SP-02005 ARCCB-TR-02017 High-Strength Steel ARCCB-TR-02006 Hydraulics ARCCB-TR-02013 Image Analysis ARCCB-TR-02012 **Image Processing** ARCCB-TR-02011 Indexes ARCCB-SP-02005 In-Situ Characterization ARCCB-TR-02014 Interior Ballistics ARCCB-TR-02001 Kinetic Hardening Model ARCCB-TR-02009 Laser Surface Treatment ARCCB-TR-02004 Lasers ARCCB-TR-02008 Liners ARCCB-TR-02016 Low Recoil Guns ARCCB-TR-02001 M256 Guns ARCCB-TR-02013 ARCCB-TR-02017 M829E3 Ammunition ARCCB-TR-02017 Magnetron Sputtering ARCCB-TR-02014 Mathematical Models ARCCB-TR-02015 Niobium ARCCB-TR-02011 Polyurethane Coatings ARCCB-TR-02012 Pressure Measurements ARCCB-TR-02013 Pressure Vessels ARCCB-TR-02006 ARCCB-TR-02009

Projectiles	ARCCB-TR-02017
Propulsion	ARCCB-TR-02001
Protective Coatings	ARCCB-TR-02004
RArefaction waVE guNs (RAVEN)	ARCCB-TR-02001
Rayleigh Waves	ARCCB-TR-02008
Real-Time X-Ray Diffraction	ARCCB-TR-02014
Recoil Mechanisms	ARCCB-TR-02007
Recoilless Rifles	ARCCB-TR-02001
Refractory Coatings	ARCCB-TR-02016
Reports	ARCCB-SP-02005
Residual Stress	ARCCB-TR-02009
Safe Maximum Pressure (SMP)	ARCCB-TR-02013
Smart Structures	ARCCB-TR-02003
Soft Recoil	ARCCB-TR-02007
Sonic Rarefaction Waves	ARCCB-TR-02001
Sputtering	ARCCB-TR-02008 ARCCB-TR-02011 ARCCB-TR-02014
Stabilization Systems	ARCCB-TR-02015
Steel	ARCCB-TR-02009
Strain Hardening	ARCCB-TR-02009
Strain Rate	ARCCB-TR-02013
Structural Properties	ARCCB-TR-02014

T. 1.0	
Tank Guns	ARCCB-TR-02001
	ARCCB-TR-02007
	ARCCB-TR-02010
	ARCCB-TR-02015
Tantalum	ARCCB-TR-02008
	ARCCB-TR-02011
	ARCCB-TR-02014
	ARCCB-TR-02016
	7IRCCB-1R-02010
Technical Publications	ARCCB-SP-02005
Thin Films	ARCCB-TR-02014
	1MCCD 11C 02014
25-mm Gun Tubes	ARCCB-TR-02016
T	
Ultrasonics	ARCCB-TR-02008
Ultraviolet Degradation	ARCCB-TR-02012
Venting	ARCCB-TR-02001
Vibration Absorbers	ARCCB-TR-02002
	ARCCB-TR-02003
Vibrations	ARCCB-TR-02002
	ARCCB-TR-02002
•	ARCCB-TR-02010
	ARCCD-1R-02010
Wavelet Analysis	ARCCB-TR-02008
Wear	ARCCB-TR-02016
···	ARCCD-1R-02010
Yield Pressure	ARCCB-TR-02006
Yield Strength	ADCCD TD 00010
r icia oncligui	ARCCB-TR-02013

AD NUMBERS – 2002

REPORT NUMBER	AD NUMBER
ARCCB-TR-02001	A398 942
ARCCB-TR-02002	A399 323
ARCCB-TR-02003	A399 837
ARCCB-TR-02004	B277 840
ARCCB-SP-02005	B278 533
ARCCB-TR-02006	A402 335
ARCCB-TR-02007	A402 105
ARCCB-TR-02008	A406 403
ARCCB-TR-02009	A405 842
ARCCB-TR-02010	A405 870
ARCCB-TR-02011	A405 463
ARCCB-TR-02012	A406 089
ARCCB-TR-02013	A406 817
ARCCB-TR-02014	A408 894
ARCCB-TR-02015	A408 136
ARCCB-TR-02016	A408 856
ARCCB-TR-02017	A410 681

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Vibration Absorber, Passive, Smart Gun Barrels, Accuracy, Vibration, 1			16. PRICE CODE
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13.	current barrel is short enough However, as the length of the increased muzzle pointing error damper. In this case the syst increases its susceptibility to to been added onto its forward of through the full range of the Different types of springs and	e one on the Abrams, are stabil that treating it as a rigid bean to tube is extended, to meet recors. A method to reduce these vern under study is an extended errain-induced vibrations. The collar. This collar is then sup- shroud's movement. Varyin:	a allows engagement of a juired muzzle exit veloci- ibrations is to use the forwall length version of the gu forward thermal shroud hoorted by springs, which g the stiffness of these s the current version uses less	nove while traversing uneven terrain. The nother tank at ranges of over a kilometer. ies, the terrain-induced vibrations lead to rard thermal shroud as part of a mass tuned in currently fielded. This extended length as been shortened and additional mass has are preloaded so that they stay in contact prings allows for tuning of the absorber. If springs and a wedge collar. This system
14.	SUBJECT TERMS Vibrations, Vibration Absorber, Car	•		15. NUMBER OF PAGES 17
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AUTHORS     Mark A. Johnson and Paul J. Cote			
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systematically determine the time scaling parameters define a unique growth processes of thick metal film	puttered tantalum and niobium cou urface structures over a range of evolution of the spatial scaling pa o universality class that is associate	scales from 10-nm to 5-0m	erms of dynamic scaling exponents using atomic. New numerical techniques are introduced to e coating surface morphology. These dynamics, and provides insight into the dynamics of the
<ol> <li>SUBJECT TERMS         Image Processing, Universality Class     </li> </ol>	ss, Dynamic Scaling Exponents, Fr	actals	15. NUMBER OF PAGES 13
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13. ABSTRACT (Maximum 200 words)  Changes in the Intrinsic structure of paint surfaces resulting from extended UV exposure can significantly alter the appearance of the breakdown in the resin that blinds the fine paint particulates. In this study, the coating structure of a solvent-based polyurethane establish correlations between the intrinsic spatial scaling properties of the coating and UV exposure time. Atomic force microscopy scanning confocal microscopy (LSCM) were employed to map surface structures over a range of scales from 100-nm to 100-10m. The polyurethane surface was characterized in terms of scaling exponents by quantifying the local roughness using detrended flux (DFA) to identify long-range power-law correlations and correct for inhomogeneities in the surface structure. This approach provide directly compare AFM and LSCM results over a range of scales consistent with those of a self-affine fractal. The time-dependent roughening process was also determined in order to provide a metric for characterizing the evolving surface morphology. The results of polyurethane coating degradation under UV exposure.	was analyzed to (AFM) and laser The roughness of actuation analysis vides a means to t dynamics of the uits provide fresh
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13. ABSTRACT (Maximum 200 words)  The M256 120-mm cannon is the main armament of the M1A1 and M1A2 tanks. With the increased pressure generated by the latest version of the M829 APFSDS-T cartridge (A3), the yield strength of the cannon would have been insufficient to prevent elastic deformation of the tube. Classical theory indicated that this pressure could not have been contained, but it was known that the theory is somewhat conservative. By testing to elastic deformation and using statistical analysis, a new Safe Maximum Pressure (SMP) as defined by NATO Standardization Agreement (STANAG) 4110, was determined. This resulted in the M256 tube yield strength being redefined and capable of firing the M829A3.					
14. SUBJECT TERMS M256, Cannon, Test, Yield, Yield S			15. NUMBER OF PAGES 15		
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AUTHORS     S.L. Lee, D. Windover (RPI, Troy,	NY), TM. Lu (RPI), and M. Audino			
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13. ABSTRACT (Maximum 200 words)  The design and construction of a planar magnetron-sputter deposition system with a beryllium chamber was accomplished to perform In-situ x-ray diffraction growth study of refractory coatings. The deposition system was set on top of a laboratory θ2θ x-ray diffractometer. A two-dimensional array detector was interfaced for observation of the Debyer rings during growth. Integration along the 2θ and χ directions allows fast phase and texture determination. The system was built to study effects of sputter deposition parameters on the structural properties of tantalum on steel, silicon, and glass substrates without exposing the system to atmosphere pressure.  Two sputter depositions of tantalum films onto glass substrate in argon gas are reported here, one was deposited at 25-mm target-detector distance, 3.9 Pascal argon gas, and the other at 108-mm target-detector distance and 1.3 Pascal argon gas. The first film grew to 250-nm in 39 minutes at an average growth rate of 6.4-mm/minute. It consisted of 45-nm of interface layer, which showed no crystalline structure, and was most likely amorphous film. It was followed by 19-nm growth of α-tantalum. From the full-width half maximum of the χ-plot, it was determined that the β-tantalum region was <002> textured, and the α-tantalum region was <110> textured, and grew more textured with deposition time. The second film grew to 36-nm in 22 minutes at an average growth rate of 1.6-nm/minute. It consisted of 31-nm of layer, which showed no crystalline structure, and was most likely amorphous film. It was followed by 5-nm of surface layer of β- and α-tantalum. Ex-situ grazing incidence x-ray diffraction performed on the film surface confirmed the In-situ results. Ex-situ pole figure analysis showed <110> fiber texture in α-tantalum, and highly <002> texture in β-tantalum.				
<ol> <li>SUBJECT TERMS         In-Situ Characterization, Magnetron Sputtering, Real-Time X-Ray Diffraction,         Tantalum, Two-Dimensional Detector     </li> </ol>			15. NUMBER OF PAGES 18 16. PRICE CODE	
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4. TITLE AND SUBTITLE MAIN BATTLE TANK FLEXIBLE O THREE-SEGMENT MODEL	4. TITLE AND SUBTITLE  MAIN BATTLE TANK FLEXIBLE GUN TUBE DISTURBANCE MODEL:				
6. AUTHORS Henry J. Sneck					
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benet Laboratories, AMSTA-AR-CCB-O Watervliet, NY 12189-4000			PERFORMING ORGANIZATION REPORT NUMBER     ARCCB-TR-02015		
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A rational approach to disturbance rejection is proposed and applied to a simple three degree-of-freedom flexible gun tube model using feedforward and feedback compensation. The first two natural frequencies of the pin-free and cantilever tube are matched by adjusting the dimensions of the rigid segments and the stiffness of the torsional springs that join them. It was found that, contrary to the previously analyzed two degree-of-freedom segment model, the muzzle-end segment could be stabilized by the proper choice of transfer functions and elevation driveline response. The analysis serves to establish the requirements for the transfer functions and stabilizing actuator systems.					
14. SUBJECT TERMS Gun Tube, Flexible, Stabilization			15. NUMBER OF PAGES 22		
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4.	TITLE AND SUBTITLE CHARACTERIZATION OF EXPLO FIRED TANTALUM LINERS APPL			5. FUNDING NUMBERS AMCMS No. 6226.24.H191.1		
6.	AUTHORS C. Mulligan, M. Audino, P. Cote, G C. Rickard, S. Smith, and M. Todar					
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13.	Characterization analyses were conducted on sections taken from three truncated 25-mm gun tubes that were explosively bonded with pure tantalum. Two of the barrels had been test fired and one was received in the pre-fired condition. The two test-fired tubes consist of one smoothbore design and one no-twist rifled bore design. The specimen received in the pre-fired condition was the smoothbore design. Characterization work included macroscopic examination, liner thickness measurements, microstructural analysis, microhardness testing, adhesion testing, scanning electron microscopy, energy dispersive spectroscopy, wavelength dispersive spectroscopy, hydrogen analysis, and pulsed laser heating. Characterization results indicate vast improvement over the erosion characteristics of standard nitrided 25-mm Bushmaster gun tubes when firing the unfielded, original M919 propellant (100% HE 9053). Some areas of concern in the performance of the liner include heavy heat-check cracking, severe gas erosion, high concentration levels of hydrogen, and surface oxidation of the tantalum liners.					
14.	SUBJECT TERMS Explosive Bonding, Tantalum. 25-m Wear, Eroslon, Refractory Coatings			15. NUMBER OF PAGES 40 16. PRICE CODE		
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6. AUTHORS S. Sopok, G. Pflegl, and C. Rickard					
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13. ABSTRACT (Maximum 200 words) Erosion modeling predictions are given for the current M829E3 round configuration and weighted averages per temperature for the computer correction factor (CCF). Our gun erosion model was developed through a ten-year joint partnership with Software and Engineering Associates, Inc., Carson City, NV. These predictions are based on recent cannon characterization data. These latest predictions Include significant changes in propellant configuration and projectile weight that were made to the current M829E3 configuration compared to our initially presented M829E3 modeling predictions two years ago. For the last two years, additional nonablative M829E3 erosion modeling predictions have not been conducted or presented. This was due to a diversion of erosion modeling resources toward ablative M829E3 erosion predictions and erosion predictions related to the selection of six M256 cannons for M829E3-related fatigue testing. For the current M829E3 configuration, these changes in gas pressure, gas temperature, gas velocity, and increased projectile weight collectively contributed to a predicted increase in M256 cannon erosion life compared to our initially presented M829E3 modeling effort. In addition, the current set of M829E3 weighted averages per temperature for CCF from Fort Knox (19% hot 49°C/120°F, 64% basic 21°C/70°F, 16% cold -7°C/20°F, and 1% severe -32°C/-25°F) collectively contributed to a further predicted increase in M256 cannon erosion life compared to the two-year-old set of weighted averages per temperature (33% basic, 0% cold, and 33% severe). For the current predictions, the peak eroded cannon axial position remains at approximately 60 inches from the rear face of the tube ±6 inches; and this position dictates the erosion life of the cannon. Erosion life predictions at this position are given for each of the round-conditioning temperatures and the Fort Knox mixture of round-conditioning temperatures. At this peak eroded position, the respective 49°C/120°F, -1°C/70°F, -32°C					
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